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## SEQUENCE LISTING

## (1) GENERAL INFORMATION:

- (i) APPLICANT: Lee, Wen-Hwa  
Shepard, H. Michael  
Gregory, Richard J.  
Wills, Ken N.  
Maneval, Daniel C.  
Lee, Eva  
Goodrich, David  
Wang, Nan-Ping
- (ii) TITLE OF INVENTION: Cell Cycle Controlling Compositions and Methods of Use
- (iii) NUMBER OF SEQUENCES: 2
- (iv) CORRESPONDENCE ADDRESS:
  - (A) ADDRESSEE: Townsend and Townsend and Crew LLP
  - (B) STREET: Two Embarcadero Center, Eighth Floor
  - (C) CITY: San Francisco
  - (D) STATE: California
  - (E) COUNTRY: USA
  - (F) ZIP: 94111-3834
- (v) COMPUTER READABLE FORM:
  - (A) MEDIUM TYPE: Floppy disk
  - (B) COMPUTER: IBM PC compatible
  - (C) OPERATING SYSTEM: PC-DOS/MS-DOS
  - (D) SOFTWARE: PatentIn Release #1.0, Version #1.30
- (vi) CURRENT APPLICATION DATA:
  - (A) APPLICATION NUMBER: US 08/472,760
  - (B) FILING DATE: 07-JUN-1995
  - (C) CLASSIFICATION:
- (vii) PRIOR APPLICATION DATA:
  - (A) APPLICATION NUMBER: US 07/951,947
  - (B) FILING DATE: 28-SEP-1992
- (vii) PRIOR APPLICATION DATA:
  - (A) APPLICATION NUMBER: US 08/276,041
  - (B) FILING DATE: 14-JUL-1994
- (vii) PRIOR APPLICATION DATA:
  - (A) APPLICATION NUMBER: US 07/764,714
  - (B) FILING DATE: 24-SEP-1991
- (vii) PRIOR APPLICATION DATA:
  - (A) APPLICATION NUMBER: US 07/265,829
  - (B) FILING DATE: 31-OCT-1988
- (vii) PRIOR APPLICATION DATA:
  - (A) APPLICATION NUMBER: US 08/225,099
  - (B) FILING DATE: 08-APR-1994
- (vii) PRIOR APPLICATION DATA:
  - (A) APPLICATION NUMBER: US 08/079,207
  - (B) FILING DATE: 17-JUN-1993

- (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 07/914,039
    - (B) FILING DATE: 14-JUL-1992
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 07/550,877
    - (B) FILING DATE: 11-JUL-1990
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 08/058,784
    - (B) FILING DATE: 07-MAY-1993
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 07/906,008
    - (B) FILING DATE: 26-JUN-1992
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 07/553,905
    - (B) FILING DATE: 16-JUL-1990
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 08/306,513
    - (B) FILING DATE: 13-SEP-1994
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 08/121,108
    - (B) FILING DATE: 13-SEP-1993
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 07/956,472
    - (B) FILING DATE: 02-OCT-1992
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 08/126,810
    - (B) FILING DATE: 24-SEP-1993
  - (vii) PRIOR APPLICATION DATA:
    - (A) APPLICATION NUMBER: US 07/778,510
    - (B) FILING DATE: 17-OCT-1991
  - (viii) ATTORNEY/AGENT INFORMATION:
    - (A) NAME: Bastian, Kevin L.
    - (B) REGISTRATION NUMBER: 34,774
    - (C) REFERENCE/DOCKET NUMBER: 17726A-000410US
  - (ix) TELECOMMUNICATION INFORMATION:
    - (A) TELEPHONE: (415) 576-0200
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- (2) INFORMATION FOR SEQ ID NO:1:
- (i) SEQUENCE CHARACTERISTICS:
    - (A) LENGTH: 2994 base pairs
    - (B) TYPE: nucleic acid
    - (C) STRANDEDNESS: single
    - (D) TOPOLOGY: linear
  - (ii) MOLECULE TYPE: DNA (genomic)

## (ix) FEATURE:

(A) NAME/KEY: CDS  
 (B) LOCATION: 139..2922  
 (D) OTHER INFORMATION: /product= "RB protein"  
 /note= "retinoblastoma (RB) gene"

## (ix) FEATURE:

(A) NAME/KEY: -  
 (B) LOCATION: 1273..2922  
 (D) OTHER INFORMATION: /note= "truncated RB protein fragment  
 p56-RB"

## (ix) FEATURE:

(A) NAME/KEY: -  
 (B) LOCATION: 2887..2922  
 (D) OTHER INFORMATION: /note= "RB protein C-terminal peptide"

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

|  |     |
|--|-----|
| TTCCGGTTTT TCTCAGGGGA CGTTGAAATT ATTTTGTAA CGGGAGTCGG GAGAGGACGG   | 60  |
| GGCGTGCCCC GCGTGCGCGC GCGTCGTCCT CCCC GGCGCT CCTCCACAGC TCGCTGGCTC | 120 |
| CCGCCGCGGA AAGGCGTC ATG CCG CCC AAA ACC CCC CGA AAA ACG GCC GCC    | 171 |
| Met Pro Pro Lys Thr Pro Arg Lys Thr Ala Ala                        |     |
| 1 5 10   |     |
| ACC GCC GCC GCT GCC GCC GCG GAA CCC CCG GCA CCG CCG CCG CCG CCC    | 219 |
| Thr Ala Ala Ala Ala Ala Ala Glu Pro Pro Ala Pro Pro Pro Pro Pro    |     |
| 15 20 25   |     |
| CCT CCT GAG GAG GAC CCA GAG CAG GAC AGC GGC CCG GAG GAC CTG CCT    | 267 |
| Pro Pro Glu Glu Asp Pro Glu Gln Asp Ser Gly Pro Glu Asp Leu Pro    |     |
| 30 35 40   |     |
| CTC GTC AGG CTT GAG TTT GAA GAA ACA GAA GAA CCT GAT TTT ACT GCA    | 315 |
| Leu Val Arg Leu Glu Phe Glu Glu Thr Glu Glu Pro Asp Phe Thr Ala    |     |
| 45 50 55   |     |
| TTA TGT CAG AAA TTA AAG ATA CCA GAT CAT GTC AGA GAG AGA GCT TGG    | 363 |
| Leu Cys Gln Lys Leu Lys Ile Pro Asp His Val Arg Glu Arg Ala Trp    |     |
| 60 65 70 75  |     |
| TTA ACT TGG GAG AAA GTT TCA TCT GTG GAT GGA GTA TTG GGA GGT TAT    | 411 |
| Leu Thr Trp Glu Lys Val Ser Ser Val Asp Gly Val Leu Gly Gly Tyr    |     |
| 80 85 90   |     |
| ATT CAA AAG AAA AAG GAA CTG TGG GGA ATC TGT ATC TTT ATT GCA GCA    | 459 |
| Ile Gln Lys Lys Lys Glu Leu Trp Gly Ile Cys Ile Phe Ile Ala Ala    |     |
| 95 100 105   |     |
| GTT GAC CTA GAT GAG ATG TCG TTC ACT TTT ACT GAG CTA CAG AAA AAC    | 507 |
| Val Asp Leu Asp Glu Met Ser Phe Thr Phe Thr Glu Leu Gln Lys Asn    |     |
| 110 115 120  |     |
| ATA GAA ATC AGT GTC CAT AAA TTC TTT AAC TTA CTA AAA GAA ATT GAT    | 555 |
| Ile Glu Ile Ser Val His Lys Phe Phe Asn Leu Leu Lys Glu Ile Asp    |     |
| 125 130 135  |     |

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| ACC | AGT | ACC | AAA | GTT | GAT | AAT | GCT | ATG | TCA | AGA | CTG | TTG | AAG | AAG | TAT | 603  |
| Thr | Ser | Thr | Lys | Val | Asp | Asn | Ala | Met | Ser | Arg | Leu | Leu | Lys | Lys | Tyr |      |
| 140 |     |     |     |     | 145 |     |     |     |     | 150 |     |     |     |     | 155 |      |
| GAT | GTA | TTG | TTT | GCA | CTC | TTC | AGC | AAA | TTG | GAA | AGG | ACA | TGT | GAA | CTT | 651  |
| Asp | Val | Leu | Phe | Ala | Leu | Phe | Ser | Lys | Leu | Glu | Arg | Thr | Cys | Glu | Leu |      |
|     |     |     |     | 160 |     |     |     |     | 165 |     |     |     |     | 170 |     |      |
| ATA | TAT | TTG | ACA | CAA | CCC | AGC | AGT | TCG | ATA | TCT | ACT | GAA | ATA | AAT | TCT | 699  |
| Ile | Tyr | Leu | Thr | Gln | Pro | Ser | Ser | Ser | Ile | Ser | Thr | Glu | Ile | Asn | Ser |      |
|     |     |     | 175 |     |     |     |     | 180 |     |     |     |     | 185 |     |     |      |
| GCA | TTG | GTG | CTA | AAA | GTT | TCT | TGG | ATC | ACA | TTT | TTA | TTA | GCT | AAA | GGG | 747  |
| Ala | Leu | Val | Leu | Lys | Val | Ser | Trp | Ile | Thr | Phe | Leu | Leu | Ala | Lys | Gly |      |
|     |     | 190 |     |     |     |     | 195 |     |     |     |     | 200 |     |     |     |      |
| GAA | GTA | TTA | CAA | ATG | GAA | GAT | GAT | CTG | GTG | ATT | TCA | TTT | CAG | TTA | ATG | 795  |
| Glu | Val | Leu | Gln | Met | Glu | Asp | Asp | Leu | Val | Ile | Ser | Phe | Gln | Leu | Met |      |
|     | 205 |     |     |     |     | 210 |     |     |     |     | 215 |     |     |     |     |      |
| CTA | TGT | GTC | CTT | GAC | TAT | TTT | ATT | AAA | CTC | TCA | CCT | CCC | ATG | TTG | CTC | 843  |
| Leu | Cys | Val | Leu | Asp | Tyr | Phe | Ile | Lys | Leu | Ser | Pro | Pro | Met | Leu | Leu |      |
| 220 |     |     |     |     | 225 |     |     |     |     | 230 |     |     |     |     | 235 |      |
| AAA | GAA | CCA | TAT | AAA | ACA | GCT | GTT | ATA | CCC | ATT | AAT | GGT | TCA | CCT | CGA | 891  |
| Lys | Glu | Pro | Tyr | Lys | Thr | Ala | Val | Ile | Pro | Ile | Asn | Gly | Ser | Pro | Arg |      |
|     |     |     |     | 240 |     |     |     |     | 245 |     |     |     |     | 250 |     |      |
| ACA | CCC | AGG | CGA | GGT | CAG | AAC | AGG | AGT | GCA | CGG | ATA | GCA | AAA | CAA | CTA | 939  |
| Thr | Pro | Arg | Arg | Gly | Gln | Asn | Arg | Ser | Ala | Arg | Ile | Ala | Lys | Gln | Leu |      |
|     |     |     | 255 |     |     |     |     | 260 |     |     |     |     | 265 |     |     |      |
| GAA | AAT | GAT | ACA | AGA | ATT | ATT | GAA | GTT | CTC | TGT | AAA | GAA | CAT | GAA | TGT | 987  |
| Glu | Asn | Asp | Thr | Arg | Ile | Ile | Glu | Val | Leu | Cys | Lys | Glu | His | Glu | Cys |      |
|     |     | 270 |     |     |     |     | 275 |     |     |     |     | 280 |     |     |     |      |
| AAT | ATA | GAT | GAG | GTG | AAA | AAT | GTT | TAT | TTC | AAA | AAT | TTT | ATA | CCT | TTT | 1035 |
| Asn | Ile | Asp | Glu | Val | Lys | Asn | Val | Tyr | Phe | Lys | Asn | Phe | Ile | Pro | Phe |      |
|     | 285 |     |     |     |     | 290 |     |     |     |     | 295 |     |     |     |     |      |
| ATG | AAT | TCT | CTT | GGA | CTT | GTA | ACA | TCT | AAT | GGA | CTT | CCA | GAG | GTT | GAA | 1083 |
| Met | Asn | Ser | Leu | Gly | Leu | Val | Thr | Ser | Asn | Gly | Leu | Pro | Glu | Val | Glu |      |
| 300 |     |     |     |     | 305 |     |     |     |     | 310 |     |     |     |     | 315 |      |
| AAT | CTT | TCT | AAA | CGA | TAC | GAA | GAA | ATT | TAT | CTT | AAA | AAT | AAA | GAT | CTA | 1131 |
| Asn | Leu | Ser | Lys | Arg | Tyr | Glu | Glu | Ile | Tyr | Leu | Lys | Asn | Lys | Asp | Leu |      |
|     |     |     |     | 320 |     |     |     |     | 325 |     |     |     |     | 330 |     |      |
| GAT | GCA | AGA | TTA | TTT | TTG | GAT | CAT | GAT | AAA | ACT | CTT | CAG | ACT | GAT | TCT | 1179 |
| Asp | Ala | Arg | Leu | Phe | Leu | Asp | His | Asp | Lys | Thr | Leu | Gln | Thr | Asp | Ser |      |
|     |     |     | 335 |     |     |     |     | 340 |     |     |     |     | 345 |     |     |      |
| ATA | GAC | AGT | TTT | GAA | ACA | CAG | AGA | ACA | CCA | CGA | AAA | AGT | AAC | CTT | GAT | 1227 |
| Ile | Asp | Ser | Phe | Glu | Thr | Gln | Arg | Thr | Pro | Arg | Lys | Ser | Asn | Leu | Asp |      |
|     |     | 350 |     |     |     |     | 355 |     |     |     |     | 360 |     |     |     |      |
| GAA | GAG | GTG | AAT | GTA | ATT | CCT | CCA | CAC | ACT | CCA | GTT | AGG | ACT | GTT | ATG | 1275 |
| Glu | Glu | Val | Asn | Val | Ile | Pro | Pro | His | Thr | Pro | Val | Arg | Thr | Val | Met |      |
|     | 365 |     |     |     |     | 370 |     |     |     |     | 375 |     |     |     |     |      |
| AAC | ACT | ATC | CAA | CAA | TTA | ATG | ATG | ATT | TTA | AAT | TCA | GCA | AGT | GAT | CAA | 1323 |

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |      |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Asn | Thr | Ile | Gln | Gln | Leu | Met | Met | Ile | Leu | Asn | Ser | Ala | Ser | Asp | Gln |      |
| 380 |     |     |     |     | 385 |     |     |     |     | 390 |     |     |     |     | 395 |      |
| CCT | TCA | GAA | AAT | CTG | ATT | TCC | TAT | TTT | AAC | AAC | TGC | ACA | GTG | AAT | CCA | 1371 |
| Pro | Ser | Glu | Asn | Leu | Ile | Ser | Tyr | Phe | Asn | Asn | Cys | Thr | Val | Asn | Pro |      |
|     |     |     |     | 400 |     |     |     |     | 405 |     |     |     |     | 410 |     |      |
| AAA | GAA | AGT | ATA | CTG | AAA | AGA | GTG | AAG | GAT | ATA | GGA | TAC | ATC | TTT | AAA | 1419 |
| Lys | Glu | Ser | Ile | Leu | Lys | Arg | Val | Lys | Asp | Ile | Gly | Tyr | Ile | Phe | Lys |      |
|     |     |     | 415 |     |     |     |     | 420 |     |     |     |     | 425 |     |     |      |
| GAG | AAA | TTT | GCT | AAA | GCT | GTG | GGA | CAG | GGT | TGT | GTC | GAA | ATT | GGA | TCA | 1467 |
| Glu | Lys | Phe | Ala | Lys | Ala | Val | Gly | Gln | Gly | Cys | Val | Glu | Ile | Gly | Ser |      |
|     |     | 430 |     |     |     |     | 435 |     |     |     |     | 440 |     |     |     |      |
| CAG | CGA | TAC | AAA | CTT | GGA | GTT | CGC | TTG | TAT | TAC | CGA | GTA | ATG | GAA | TCC | 1515 |
| Gln | Arg | Tyr | Lys | Leu | Gly | Val | Arg | Leu | Tyr | Tyr | Arg | Val | Met | Glu | Ser |      |
|     | 445 |     |     |     |     | 450 |     |     |     |     | 455 |     |     |     |     |      |
| ATG | CTT | AAA | TCA | GAA | GAA | GAA | CGA | TTA | TCC | ATT | CAA | AAT | TTT | AGC | AAA | 1563 |
| Met | Leu | Lys | Ser | Glu | Glu | Glu | Arg | Leu | Ser | Ile | Gln | Asn | Phe | Ser | Lys |      |
| 460 |     |     |     |     | 465 |     |     |     |     | 470 |     |     |     |     | 475 |      |
| CTT | CTG | AAT | GAC | AAC | ATT | TTT | CAT | ATG | TCT | TTA | TTG | GCG | TGC | GCT | CTT | 1611 |
| Leu | Leu | Asn | Asp | Asn | Ile | Phe | His | Met | Ser | Leu | Leu | Ala | Cys | Ala | Leu |      |
|     |     |     |     | 480 |     |     |     |     | 485 |     |     |     |     | 490 |     |      |
| GAG | GTT | GTA | ATG | GCC | ACA | TAT | AGC | AGA | AGT | ACA | TCT | CAG | AAT | CTT | GAT | 1659 |
| Glu | Val | Val | Met | Ala | Thr | Tyr | Ser | Arg | Ser | Thr | Ser | Gln | Asn | Leu | Asp |      |
|     |     |     | 495 |     |     |     |     | 500 |     |     |     |     | 505 |     |     |      |
| TCT | GGA | ACA | GAT | TTG | TCT | TTC | CCA | TGG | ATT | CTG | AAT | GTG | CTT | AAT | TTA | 1707 |
| Ser | Gly | Thr | Asp | Leu | Ser | Phe | Pro | Trp | Ile | Leu | Asn | Val | Leu | Asn | Leu |      |
|     |     | 510 |     |     |     |     | 515 |     |     |     |     | 520 |     |     |     |      |
| AAA | GCC | TTT | GAT | TTT | TAC | AAA | GTG | ATC | GAA | AGT | TTT | ATC | AAA | GCA | GAA | 1755 |
| Lys | Ala | Phe | Asp | Phe | Tyr | Lys | Val | Ile | Glu | Ser | Phe | Ile | Lys | Ala | Glu |      |
|     | 525 |     |     |     |     | 530 |     |     |     |     | 535 |     |     |     |     |      |
| GGC | AAC | TTG | ACA | AGA | GAA | ATG | ATA | AAA | CAT | TTA | GAA | CGA | TGT | GAA | CAT | 1803 |
| Gly | Asn | Leu | Thr | Arg | Glu | Met | Ile | Lys | His | Leu | Glu | Arg | Cys | Glu | His |      |
| 540 |     |     |     |     | 545 |     |     |     |     | 550 |     |     |     |     | 555 |      |
| CGA | ATC | ATG | GAA | TCC | CTT | GCA | TGG | CTC | TCA | GAT | TCA | CCT | TTA | TTT | GAT | 1851 |
| Arg | Ile | Met | Glu | Ser | Leu | Ala | Trp | Leu | Ser | Asp | Ser | Pro | Leu | Phe | Asp |      |
|     |     |     |     | 560 |     |     |     |     | 565 |     |     |     |     | 570 |     |      |
| CTT | ATT | AAA | CAA | TCA | AAG | GAC | CGA | GAA | GGA | CCA | ACT | GAT | CAC | CTT | GAA | 1899 |
| Leu | Ile | Lys | Gln | Ser | Lys | Asp | Arg | Glu | Gly | Pro | Thr | Asp | His | Leu | Glu |      |
|     |     |     | 575 |     |     |     |     | 580 |     |     |     |     | 585 |     |     |      |
| TCT | GCT | TGT | CCT | CTT | AAT | CTT | CCT | CTC | CAG | AAT | AAT | CAC | ACT | GCA | GCA | 1947 |
| Ser | Ala | Cys | Pro | Leu | Asn | Leu | Pro | Leu | Gln | Asn | Asn | His | Thr | Ala | Ala |      |
|     |     | 590 |     |     |     |     | 595 |     |     |     |     | 600 |     |     |     |      |
| GAT | ATG | TAT | CTT | TCT | CCT | GTA | AGA | TCT | CCA | AAG | AAA | AAA | GGT | TCA | ACT | 1995 |
| Asp | Met | Tyr | Leu | Ser | Pro | Val | Arg | Ser | Pro | Lys | Lys | Lys | Gly | Ser | Thr |      |
|     | 605 |     |     |     |     | 610 |     |     |     |     | 615 |     |     |     |     |      |
| ACG | CGT | GTA | AAT | TCT | ACT | GCA | AAT | GCA | GAG | ACA | CAA | GCA | ACC | TCA | GCC | 2043 |
| Thr | Arg | Val | Asn | Ser | Thr | Ala | Asn | Ala | Glu | Thr | Gln | Ala | Thr | Ser | Ala |      |

| 620   | 625   |  |  |  |  |  |  | 630             |  |  |  |  |  |  | 635 |  |  |      |
|---|---|--|--|--|--|--|--|-----------------|--|--|--|--|--|--|-----|--|--|------|
| TTC CAG ACC CAG AAG CCA TTG AAA TCT ACC TCT CTT TCA CTG TTT TAT | Phe Gln Thr Gln Lys Pro Leu Lys Ser Thr Ser Leu Ser Leu Phe Tyr |  |  |  |  |  |  | 640 645 650     |  |  |  |  |  |  |     |  |  | 2091 |
| AAA AAA GTG TAT CGG CTA GCC TAT CTC CGG CTA AAT ACA CTT TGT GAA | Lys Lys Val Tyr Arg Leu Ala Tyr Leu Arg Leu Asn Thr Leu Cys Glu |  |  |  |  |  |  | 655 660 665     |  |  |  |  |  |  |     |  |  | 2139 |
| CGC CTT CTG TCT GAG CAC CCA GAA TTA GAA CAT ATC ATC TGG ACC CTT | Arg Leu Ser Glu His Pro Glu Leu Glu His Ile Ile Trp Thr Leu     |  |  |  |  |  |  | 670 675 680     |  |  |  |  |  |  |     |  |  | 2187 |
| TTC CAG CAC ACC CTG CAG AAT GAG TAT GAA CTC ATG AGA GAC AGG CAT | Phe Gln His Thr Leu Gln Asn Glu Tyr Glu Leu Met Arg Asp Arg His |  |  |  |  |  |  | 685 690 695     |  |  |  |  |  |  |     |  |  | 2235 |
| TTG GAC CAA ATT ATG ATG TGT TCC ATG TAT GGC ATA TGC AAA GTG AAG | Leu Asp Gln Ile Met Met Cys Ser Met Tyr Gly Ile Cys Lys Val Lys |  |  |  |  |  |  | 700 705 710 715 |  |  |  |  |  |  |     |  |  | 2283 |
| AAT ATA GAC CTT AAA TTC AAA ATC ATT GTA ACA GCA TAC AAG GAT CTT | Asn Ile Asp Leu Lys Phe Lys Ile Ile Val Thr Ala Tyr Lys Asp Leu |  |  |  |  |  |  | 720 725 730     |  |  |  |  |  |  |     |  |  | 2331 |
| CCT CAT GCT GTT CAG GAG ACA TTC AAA CGT GTT TTG ATC AAA GAA GAG | Pro His Ala Val Gln Glu Thr Phe Lys Arg Val Leu Ile Lys Glu Glu |  |  |  |  |  |  | 735 740 745     |  |  |  |  |  |  |     |  |  | 2379 |
| GAG TAT GAT TCT ATT ATA GTA TTC TAT AAC TCG GTC TTC ATG CAG AGA | Glu Tyr Asp Ser Ile Ile Val Phe Tyr Asn Ser Val Phe Met Gln Arg |  |  |  |  |  |  | 750 755 760     |  |  |  |  |  |  |     |  |  | 2427 |
| CTG AAA ACA AAT ATT TTG CAG TAT GCT TCC ACC AGG CCC CCT ACC TTG | Leu Lys Thr Asn Ile Leu Gln Tyr Ala Ser Thr Arg Pro Pro Thr Leu |  |  |  |  |  |  | 765 770 775     |  |  |  |  |  |  |     |  |  | 2475 |
| TCA CCA ATA CCT CAC ATT CCT CGA AGC CCT TAC AAG TTT CCT AGT TCA | Ser Pro Ile Pro His Ile Pro Arg Ser Pro Tyr Lys Phe Pro Ser Ser |  |  |  |  |  |  | 780 785 790 795 |  |  |  |  |  |  |     |  |  | 2523 |
| CCC TTA CGG ATT CCT GGA GGG AAC ATC TAT ATT TCA CCC CTG AAG AGT | Pro Leu Arg Ile Pro Gly Gly Asn Ile Tyr Ile Ser Pro Leu Lys Ser |  |  |  |  |  |  | 800 805 810     |  |  |  |  |  |  |     |  |  | 2571 |
| CCA TAT AAA ATT TCA GAA GGT CTG CCA ACA CCA ACA AAA ATG ACT CCA | Pro Tyr Lys Ile Ser Glu Gly Leu Pro Thr Pro Thr Lys Met Thr Pro |  |  |  |  |  |  | 815 820 825     |  |  |  |  |  |  |     |  |  | 2619 |
| AGA TCA AGA ATC TTA GTA TCA ATT GGT GAA TCA TTC GGG ACT TCT GAG | Arg Ser Arg Ile Leu Val Ser Ile Gly Glu Ser Phe Gly Thr Ser Glu |  |  |  |  |  |  | 830 835 840     |  |  |  |  |  |  |     |  |  | 2667 |
| AAG TTC CAG AAA ATA AAT CAG ATG GTA TGT AAC AGC GAC CGT GTG CTC | Lys Phe Gln Lys Ile Asn Gln Met Val Cys Asn Ser Asp Arg Val Leu |  |  |  |  |  |  | 845 850 855     |  |  |  |  |  |  |     |  |  | 2715 |
| AAA AGA AGT GCT GAA GGA AGC AAC CCT CCT AAA CCA CTG AAA AAA CTA | Lys Arg Ser Ala Glu Gly Ser Asn Pro Pro Lys Pro Leu Lys Lys Leu |  |  |  |  |  |  | 860 865 870 875 |  |  |  |  |  |  |     |  |  | 2763 |

|   |      |
|---|------|
| CGC TTT GAT ATT GAA GGA TCA GAT GAA GCA GAT GGA AGT AAA CAT CTC | 2811 |
| Arg Phe Asp Ile Glu Gly Ser Asp Glu Ala Asp Gly Ser Lys His Leu |      |
| 880 885 890   |      |
|   |      |
| CCA GGA GAG TCC AAA TTT CAG CAG AAA CTG GCA GAA ATG ACT TCT ACT | 2859 |
| Pro Gly Glu Ser Lys Phe Gln Gln Lys Leu Ala Glu Met Thr Ser Thr |      |
| 895 900 905   |      |
|   |      |
| CGA ACA CGA ATG CAA AAG CAG AAA ATG AAT GAT AGC ATG GAT ACC TCA | 2907 |
| Arg Thr Arg Met Gln Lys Gln Lys Met Asn Asp Ser Met Asp Thr Ser |      |
| 910 915 920   |      |
|   |      |
| AAC AAG GAA GAG AAA TGAGGATCTC AGGACCTTGG TGGACACTGT GTACACCTCT | 2962 |
| Asn Lys Glu Glu Lys   |      |
| 925   |      |
|   |      |
| GGATTCATTG TCTCTCACAG ATGTGACTGT AT                             | 2994 |

## (2) INFORMATION FOR SEQ ID NO:2:

## (i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 928 amino acids
- (B) TYPE: amino acid
- (D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

|   |  |
|---|--|
| Met Pro Pro Lys Thr Pro Arg Lys Thr Ala Ala Thr Ala Ala Ala Ala |  |
| 1 5 10 15   |  |
|   |  |
| Ala Ala Glu Pro Pro Ala Pro Pro Pro Pro Pro Pro Pro Glu Glu Asp |  |
| 20 25 30  |  |
|   |  |
| Pro Glu Gln Asp Ser Gly Pro Glu Asp Leu Pro Leu Val Arg Leu Glu |  |
| 35 40 45  |  |
|   |  |
| Phe Glu Glu Thr Glu Glu Pro Asp Phe Thr Ala Leu Cys Gln Lys Leu |  |
| 50 55 60  |  |
|   |  |
| Lys Ile Pro Asp His Val Arg Glu Arg Ala Trp Leu Thr Trp Glu Lys |  |
| 65 70 75 80   |  |
|   |  |
| Val Ser Ser Val Asp Gly Val Leu Gly Gly Tyr Ile Gln Lys Lys Lys |  |
| 85 90 95  |  |
|   |  |
| Glu Leu Trp Gly Ile Cys Ile Phe Ile Ala Ala Val Asp Leu Asp Glu |  |
| 100 105 110   |  |
|   |  |
| Met Ser Phe Thr Phe Thr Glu Leu Gln Lys Asn Ile Glu Ile Ser Val |  |
| 115 120 125   |  |
|   |  |
| His Lys Phe Phe Asn Leu Leu Lys Glu Ile Asp Thr Ser Thr Lys Val |  |
| 130 135 140   |  |
|   |  |
| Asp Asn Ala Met Ser Arg Leu Leu Lys Lys Tyr Asp Val Leu Phe Ala |  |
| 145 150 155 160   |  |



|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|
| Leu | Phe | Ser | Lys | Leu | Glu | Arg | Thr | Cys | Glu | Leu | Ile | Tyr | Leu | Thr | Gln |  |
|     |     |     |     | 165 |     |     |     |     | 170 |     |     |     |     | 175 |     |  |
| Pro | Ser | Ser | Ser | Ile | Ser | Thr | Glu | Ile | Asn | Ser | Ala | Leu | Val | Leu | Lys |  |
|     |     |     | 180 |     |     |     |     | 185 |     |     |     |     | 190 |     |     |  |
| Val | Ser | Trp | Ile | Thr | Phe | Leu | Leu | Ala | Lys | Gly | Glu | Val | Leu | Gln | Met |  |
|     |     | 195 |     |     |     |     | 200 |     |     |     |     | 205 |     |     |     |  |
| Glu | Asp | Asp | Leu | Val | Ile | Ser | Phe | Gln | Leu | Met | Leu | Cys | Val | Leu | Asp |  |
|     | 210 |     |     |     |     | 215 |     |     |     |     | 220 |     |     |     |     |  |
| Tyr | Phe | Ile | Lys | Leu | Ser | Pro | Pro | Met | Leu | Leu | Lys | Glu | Pro | Tyr | Lys |  |
| 225 |     |     |     |     | 230 |     |     |     |     | 235 |     |     |     |     | 240 |  |
| Thr | Ala | Val | Ile | Pro | Ile | Asn | Gly | Ser | Pro | Arg | Thr | Pro | Arg | Arg | Gly |  |
|     |     |     |     | 245 |     |     |     |     | 250 |     |     |     |     | 255 |     |  |
| Gln | Asn | Arg | Ser | Ala | Arg | Ile | Ala | Lys | Gln | Leu | Glu | Asn | Asp | Thr | Arg |  |
|     |     |     | 260 |     |     |     |     | 265 |     |     |     |     | 270 |     |     |  |
| Ile | Ile | Glu | Val | Leu | Cys | Lys | Glu | His | Glu | Cys | Asn | Ile | Asp | Glu | Val |  |
|     |     | 275 |     |     |     |     | 280 |     |     |     |     | 285 |     |     |     |  |
| Lys | Asn | Val | Tyr | Phe | Lys | Asn | Phe | Ile | Pro | Phe | Met | Asn | Ser | Leu | Gly |  |
|     | 290 |     |     |     |     | 295 |     |     |     |     | 300 |     |     |     |     |  |
| Leu | Val | Thr | Ser | Asn | Gly | Leu | Pro | Glu | Val | Glu | Asn | Leu | Ser | Lys | Arg |  |
| 305 |     |     |     |     | 310 |     |     |     |     | 315 |     |     |     |     | 320 |  |
| Tyr | Glu | Glu | Ile | Tyr | Leu | Lys | Asn | Lys | Asp | Leu | Asp | Ala | Arg | Leu | Phe |  |
|     |     |     |     | 325 |     |     |     |     | 330 |     |     |     |     | 335 |     |  |
| Leu | Asp | His | Asp | Lys | Thr | Leu | Gln | Thr | Asp | Ser | Ile | Asp | Ser | Phe | Glu |  |
|     |     |     | 340 |     |     |     |     | 345 |     |     |     |     | 350 |     |     |  |
| Thr | Gln | Arg | Thr | Pro | Arg | Lys | Ser | Asn | Leu | Asp | Glu | Glu | Val | Asn | Val |  |
|     |     | 355 |     |     |     |     | 360 |     |     |     |     | 365 |     |     |     |  |
| Ile | Pro | Pro | His | Thr | Pro | Val | Arg | Thr | Val | Met | Asn | Thr | Ile | Gln | Gln |  |
|     | 370 |     |     |     |     | 375 |     |     |     |     | 380 |     |     |     |     |  |
| Leu | Met | Met | Ile | Leu | Asn | Ser | Ala | Ser | Asp | Gln | Pro | Ser | Glu | Asn | Leu |  |
| 385 |     |     |     |     | 390 |     |     |     |     | 395 |     |     |     |     | 400 |  |
| Ile | Ser | Tyr | Phe | Asn | Asn | Cys | Thr | Val | Asn | Pro | Lys | Glu | Ser | Ile | Leu |  |
|     |     |     |     | 405 |     |     |     |     | 410 |     |     |     |     | 415 |     |  |
| Lys | Arg | Val | Lys | Asp | Ile | Gly | Tyr | Ile | Phe | Lys | Glu | Lys | Phe | Ala | Lys |  |
|     |     |     | 420 |     |     |     |     | 425 |     |     |     |     | 430 |     |     |  |
| Ala | Val | Gly | Gln | Gly | Cys | Val | Glu | Ile | Gly | Ser | Gln | Arg | Tyr | Lys | Leu |  |
|     |     | 435 |     |     |     |     | 440 |     |     |     |     | 445 |     |     |     |  |
| Gly | Val | Arg | Leu | Tyr | Tyr | Arg | Val | Met | Glu | Ser | Met | Leu | Lys | Ser | Glu |  |
|     | 450 |     |     |     |     | 455 |     |     |     |     | 460 |     |     |     |     |  |
| Glu | Glu | Arg | Leu | Ser | Ile | Gln | Asn | Phe | Ser | Lys | Leu | Leu | Asn | Asp | Asn |  |
| 465 |     |     |     |     | 470 |     |     |     |     | 475 |     |     |     |     | 480 |  |
| Ile | Phe | His | Met | Ser | Leu | Leu | Ala | Cys | Ala | Leu | Glu | Val | Val | Met | Ala |  |

| 485 |     |     |     |     | 490 |     |     |     |     | 495 |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Thr | Tyr | Ser | Arg | Ser | Thr | Ser | Gln | Asn | Leu | Asp | Ser | Gly | Thr | Asp | Leu |
|     |     |     | 500 |     |     |     |     | 505 |     |     |     |     | 510 |     |     |
| Ser | Phe | Pro | Trp | Ile | Leu | Asn | Val | Leu | Asn | Leu | Lys | Ala | Phe | Asp | Phe |
|     |     | 515 |     |     |     |     | 520 |     |     |     |     | 525 |     |     |     |
| Tyr | Lys | Val | Ile | Glu | Ser | Phe | Ile | Lys | Ala | Glu | Gly | Asn | Leu | Thr | Arg |
|     | 530 |     |     |     |     | 535 |     |     |     |     | 540 |     |     |     |     |
| Glu | Met | Ile | Lys | His | Leu | Glu | Arg | Cys | Glu | His | Arg | Ile | Met | Glu | Ser |
| 545 |     |     |     |     | 550 |     |     |     |     | 555 |     |     |     |     | 560 |
| Leu | Ala | Trp | Leu | Ser | Asp | Ser | Pro | Leu | Phe | Asp | Leu | Ile | Lys | Gln | Ser |
|     |     |     |     | 565 |     |     |     |     | 570 |     |     |     |     | 575 |     |
| Lys | Asp | Arg | Glu | Gly | Pro | Thr | Asp | His | Leu | Glu | Ser | Ala | Cys | Pro | Leu |
|     |     |     | 580 |     |     |     |     | 585 |     |     |     |     | 590 |     |     |
| Asn | Leu | Pro | Leu | Gln | Asn | Asn | His | Thr | Ala | Ala | Asp | Met | Tyr | Leu | Ser |
|     |     | 595 |     |     |     |     | 600 |     |     |     |     | 605 |     |     |     |
| Pro | Val | Arg | Ser | Pro | Lys | Lys | Lys | Gly | Ser | Thr | Thr | Arg | Val | Asn | Ser |
|     | 610 |     |     |     |     | 615 |     |     |     |     | 620 |     |     |     |     |
| Thr | Ala | Asn | Ala | Glu | Thr | Gln | Ala | Thr | Ser | Ala | Phe | Gln | Thr | Gln | Lys |
| 625 |     |     |     |     | 630 |     |     |     |     | 635 |     |     |     |     | 640 |
| Pro | Leu | Lys | Ser | Thr | Ser | Leu | Ser | Leu | Phe | Tyr | Lys | Lys | Val | Tyr | Arg |
|     |     |     |     | 645 |     |     |     |     | 650 |     |     |     |     | 655 |     |
| Leu | Ala | Tyr | Leu | Arg | Leu | Asn | Thr | Leu | Cys | Glu | Arg | Leu | Leu | Ser | Glu |
|     |     |     | 660 |     |     |     |     | 665 |     |     |     |     | 670 |     |     |
| His | Pro | Glu | Leu | Glu | His | Ile | Ile | Trp | Thr | Leu | Phe | Gln | His | Thr | Leu |
|     |     | 675 |     |     |     |     | 680 |     |     |     |     | 685 |     |     |     |
| Gln | Asn | Glu | Tyr | Glu | Leu | Met | Arg | Asp | Arg | His | Leu | Asp | Gln | Ile | Met |
|     | 690 |     |     |     |     | 695 |     |     |     |     | 700 |     |     |     |     |
| Met | Cys | Ser | Met | Tyr | Gly | Ile | Cys | Lys | Val | Lys | Asn | Ile | Asp | Leu | Lys |
| 705 |     |     |     |     | 710 |     |     |     |     | 715 |     |     |     |     | 720 |
| Phe | Lys | Ile | Ile | Val | Thr | Ala | Tyr | Lys | Asp | Leu | Pro | His | Ala | Val | Gln |
|     |     |     |     | 725 |     |     |     |     | 730 |     |     |     |     | 735 |     |
| Glu | Thr | Phe | Lys | Arg | Val | Leu | Ile | Lys | Glu | Glu | Glu | Tyr | Asp | Ser | Ile |
|     |     |     | 740 |     |     |     |     | 745 |     |     |     |     | 750 |     |     |
| Ile | Val | Phe | Tyr | Asn | Ser | Val | Phe | Met | Gln | Arg | Leu | Lys | Thr | Asn | Ile |
|     |     | 755 |     |     |     |     | 760 |     |     |     |     | 765 |     |     |     |
| Leu | Gln | Tyr | Ala | Ser | Thr | Arg | Pro | Pro | Thr | Leu | Ser | Pro | Ile | Pro | His |
|     | 770 |     |     |     |     | 775 |     |     |     |     | 780 |     |     |     |     |
| Ile | Pro | Arg | Ser | Pro | Tyr | Lys | Phe | Pro | Ser | Ser | Pro | Leu | Arg | Ile | Pro |
| 785 |     |     |     |     | 790 |     |     |     |     | 795 |     |     |     |     | 800 |
| Gly | Gly | Asn | Ile | Tyr | Ile | Ser | Pro | Leu | Lys | Ser | Pro | Tyr | Lys | Ile | Ser |
|     |     |     |     | 805 |     |     |     |     | 810 |     |     |     |     | 815 |     |

|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| Glu | Gly | Leu | Pro | Thr | Pro | Thr | Lys | Met | Thr | Pro | Arg | Ser | Arg | Ile | Leu |
|     |     |     | 820 |     |     |     |     | 825 |     |     |     |     | 830 |     |     |
| Val | Ser | Ile | Gly | Glu | Ser | Phe | Gly | Thr | Ser | Glu | Lys | Phe | Gln | Lys | Ile |
|     |     | 835 |     |     |     |     | 840 |     |     |     |     | 845 |     |     |     |
| Asn | Gln | Met | Val | Cys | Asn | Ser | Asp | Arg | Val | Leu | Lys | Arg | Ser | Ala | Glu |
|     |     | 850 |     |     |     | 855 |     |     |     |     | 860 |     |     |     |     |
| Gly | Ser | Asn | Pro | Pro | Lys | Pro | Leu | Lys | Lys | Leu | Arg | Phe | Asp | Ile | Glu |
| 865 |     |     |     |     | 870 |     |     |     |     | 875 |     |     |     |     | 880 |
| Gly | Ser | Asp | Glu | Ala | Asp | Gly | Ser | Lys | His | Leu | Pro | Gly | Glu | Ser | Lys |
|     |     |     |     | 885 |     |     |     |     | 890 |     |     |     |     | 895 |     |
| Phe | Gln | Gln | Lys | Leu | Ala | Glu | Met | Thr | Ser | Thr | Arg | Thr | Arg | Met | Gln |
|     |     |     | 900 |     |     |     |     | 905 |     |     |     |     | 910 |     |     |
| Lys | Gln | Lys | Met | Asn | Asp | Ser | Met | Asp | Thr | Ser | Asn | Lys | Glu | Glu | Lys |
|     |     | 915 |     |     |     |     | 920 |     |     |     |     | 925 |     |     |     |